Semi-annual Eos Contract Report -- Report #30
Period: January 1 - June 30, 1994
Remote Sensing Group (RSG), Optical Sciences Center (OSC) at the University of Arizona
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Contract Number: NAS5-31717
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Introduction: This report contains ten sections. Each section presents a different aspect of work performed under our contract. If appropriate, each section covers five areas; task objective, work accomplished, data/analysis/interpretations, anticipated future actions, and problems/corrective actions. The ten sections are: 1) Science team support activities; 2) Cross-calibration radiometers; 3) Reflectomobile; 4) Mobile laboratory; 5) Shortwave infrared (SWIR) radiometer; 6) Bi-directional reflectance distribution function (BRDF) meter; 7) Diffuse-to-global meter; 8) Calibration laboratory; 9) Algorithm and code development; and 10) Field experiments.

The group hired B. Ernie Nelson as an additional staff person during the month of February. Nelson previously worked for the Hughes Corporation in Tucson where he performed similar tasks to those he will perform as part of the RSG. His primary duties are to help with instrument assembly and repair, and to aid in equipping our calibration and instrument assembly facilities.

Science Team Support Activities: This section refers to all work performed in support of MODIS and ASTER team activities as well as work performed for other sensor teams. Over the past six months this included the attendance at team and other related meetings and completing assigned action items.

ASTER Activities: P. Slater and K. Thome travelled to Pasadena for the ASTER Algorithm Theoretical Basis Document (ATBD) Review Meeting at JPL February 17 and 18. Thome presented the ATBD for the atmospheric correction in the solar reflective. Slater wrote a report, part of which was forwarded by A. Kahle to M. King, P. Sellers, and V. Salomonson, regarding preflight, algorithm cross-comparisons. Thome met on February 15 with B. Eng, C. Voge, and M. Pniel to discuss the atmospheric correction development status and plans. It was agreed that the Remote Sensing Group should have the capability to develop the look-up table and that a target run-time for generating the table should be 3 months with a maximum of 5 months. Biggar and Thome examined the hardware requirements to do this and included these in an updated SCF requirements document submitted to C. Leff of JPL in June. Thome also met with F. Palluconi of JPL and T. Takashima of MRI on February 16 to discuss the status of the atmospheric correction algorithms. Slater and Thome attended an ASTER Level-1 ATBD meeting held at JPL March 7 and 8. Slater sent comments to Kahle regarding the radiometric calibration portion of the ATBD.

Thome attended the ASTER Software Requirements Review on April 18, and Slater and Thome attended the US ASTER Science Team Meeting held April 19 and 20 at JPL. Slater summarized the action items from the last joint team meeting and the general status of interaction with the Japanese on calibration issues. Slater and Thome attended the second week of the ATBD reviews held May 16 and 17 which covered ASTER, MOPITT, LIS, and Seawinds. Slater pointed out that vicarious calibration will be relied upon heavily for ASTER in-flight calibration because of questions surrounding the quality of the data from the ASTER on-board calibrators. Thome presented the ATBD for the atmospheric correction of ASTER data in the solar-reflective portion of the spectrum. On May 17, Kahle, D. Nichols and Slater met with King and Sellers regarding several calibration issues, including: transfer radiometers for the IR; cryogenically-cooled, active-cavity radiometers; vicarious calibration; and lunar calibration, Slater attended the SWAMP meeting on May 18.

Slater, P. Spyak, and Thome attended the joint ASTER science team meeting in Pasadena from May 24-27, 1994. With regard to calibration, a good deal of discussion centered on preparation for the ASTER Calibration Peer Review in November in Japan. Slater proposed a schedule to the Japanese for revising A. Ono's earlier Calibration Plan, which emphasized preflight and on-board radiometric calibration. The proposed Calibration Plan includes preflight cross calibration, vicarious calibration, in-flight cross calibration, calibration data weighting and merging, preflight and in-flight geometrical calibration, and the level 1-B algorithm, in addition to preflight and on-board calibration. Thome reviewed the results of the Solar Reflective Atmospheric Correction ATBD development and review to the Atmospheric Correction Working Group and an overview of the current atmospheric correction algorithms to the Temperature/Emissivity Separation Working Group.

On June 7, S. Hook, Kahle, A. Morrison, Nichols, Palluconi, and J. Schieldge, JPL members and associates of the ASTER team, met in Tucson with S. Biggar, Slater, Spyak, and Thome. The meeting was held to 1) exchange ideas and plans for work on ASTER calibration and data validation; 2) ensure that no measurement activities had been overlooked or incorrectly assumed to be the responsibility of the other group; 3) ensure that no unnecessary duplication of effort would occur; and 4) explore the possibility of joint field campaigns. In addition to these topics, discussions included preflight, cross-calibration work and the status of a white paper on thermal infrared radiometers. The general conclusion was that there were few surprises and that the capabilities of the two groups generally complemented one another. Several advantages were seen in holding joint field campaigns and we are planning the first of these in Spring of 1995.

Slater responded to three action items that resulted from the Joint ASTER Science team meeting in May. The first concerned a method for characterizing stray light, this response was sent to Sakuma. The second action item related to the problem of combining calibration data results. Slater sent a description of a general procedure to Ono for his comments and additions. The third action item concerned inputs to the ASTER Calibration Plan. Chapters on preflight cross calibration, in-flight vicarious calibration, and in-flight cross calibration with respect to other sensors were sent to Sakuma and Yamaguchi for comment and inclusion in the Calibration Plan.

MODIS Activities: Slater and Spyak travelled to Washington, D. C. for a MODIS In-flight Thermal IR Calibration Algorithm Workshop and to review with P. Menzel the status of and inputs to the MODIS Calibration Plan on January 13 and 14. Slater sent a letter to Salomonson regarding follow-up to the IR action items. Biggar and Spyak attended the MODIS CDR at Santa Barbara Research Center on January 18-20. Both Biggar and Spyak sent comments about the review to Salomonson and R. Weber. Slater and Spyak attended the MODIS Calibration Plan meeting at GSFC on March 3. Biggar and Slater attended and gave five presentations at a dry run of the MODIS Calibration Plan Review at GSFC held March 16 and 17. Slater and Spyak worked on combining the inputs to the MODIS Calibration Plan. The first version of the document was delivered to GSFC on March 25 in time for the MODIS Calibration Peer Review, April 13 and 14 at GSFC. Biggar and Slater made five presentations at the review, which Slater also chaired. S. Reber chaired the review panel.

Biggar and Slater attended the MODIS Science Team meeting in Greenbelt during May 4 to 6, 1994. May 5 was spent reviewing several issues including the effect of the MODIS replan on the SBRC testing program, the status of the primary mirror scattered light problem, and IR in-flight cross calibration. The inadequacies identified in the peer review of the MODIS Calibration Plan, which was referred to as an ATBD, held April 13 and 14, were also discussed. These were briefly reviewed in the plenary session on May 6. Biggar and Slater then attended the ATBD review for MODIS, MISR, and CERES held May 9-11 in Landover, Maryland. May 7-9 were spent preparing for the MODIS Level-1 ATBD review. Specifically, Biggar and Slater developed a flow chart of the level-1B data preparation and prepared talks regarding prioritization of calibration methods and weighting the various calibration inputs. Slater presented the MODIS Level-1 ATBD (which is the Calibration Plan). Although it suffered from being under the shadow of the April review criticisms and apparent misunderstanding regarding the applicability of vicarious calibration, the May review generally went much better.

Other Eos Related Activities: Thome travelled to San Antonio for the EOS IWG meeting January 11-13. Slater attended the Spectral Signatures meeting in Val d'Isere, France during the week of January 17. He presented a paper co-authored by Biggar and Thome titled "Unified pre- and in-flight calibration of satellite sensors." Biggar attended the IVOS WGCV CEOS meeting in Seattle held February 22 and 23. Slater submitted two sections to A. Ono's calibration paper and submitted a title and abstract to Fujisada's session on Level-1 ASTER processing for the Rome SPIE meeting in September of this year. From February 28 to March 2, Biggar, Slater, and Spyak attended the EOS Calibration Panel meeting in Rockville and the MOPITT calibration peer review. Spyak presented early thermal transfer radiometer design considerations at the EOS Calibration meeting.

Biggar and Slater attended a SeaWiFS Calibration Working Group meeting on April 12 at GSFC. Biggar gave a talk describing the March and November 1993 preflight, solar-radiation-based-calibration results for SeaWiFS. The agreement with the spherical-integrating source results was generally better than 3%. An error analysis shows the method can provide uncertainties less than 3% with respect to the sun. A report from W. Barnes at GSFC stated SBRC is seriously considering using solar-radiation-based calibration for MODIS. Biggar wrote and submitted a paper entitled "Solar-radiation-based absolute calibration of optical sensors: SeaWiFS and a Daedalus 1268," for IGARSS '94. Thome prepared two papers for IGARSS and submitted them. The first paper is entitled "Proposed atmospheric correction for the solar-reflective bands of the Advanced Spaceborne Thermal Emission and Reflection Radiometer." The second is entitled "Absolute-radiometric calibration of Landsat-5 Thematic Mapper and the proposed calibration of the Advanced Spaceborne Thermal Emission and Reflection Radiometer."

Biggar and Slater reviewed three ATBDs from MODIS and MISR, and Spyak reviewed the MOPITT Level 1 processing ATBD and all three sent comments to King. Thome also updated the EOS Statement of Work for submission to ASTER and he and Biggar updated the Science Computing Facilities Document and submitted this to C. Leff of JPL. Biggar, Slater, and Spyak revised the group's budget input for both ASTER and MODIS in March. Biggar continued work on the EOS contract budget throughout the period to determine the cost of a thermal IR cross-calibration transfer radiometer (both vacuum and ambient). Biggar presented current research activities of the RSG to the DOE MTI group at Los Alamos National Laboratory on June 17.

Cross-Calibration Radiometers: This section describes work to design, fabricate, test, and calibrate a set of preflight cross-calibration radiometers (CCRs). These radiometers were originally supposed to cover the wavelength region from 400 to 14500 nm. To accomplish this, several separate radiometers will be constructed, each optimized for a specific portion of the spectrum. They will have very low stray light and polarization responses, exhibit sharp, well-defined fields of view and spectral response profiles, and be ultrastable with respect to temperature and time. The radiometers will be used to provide an important independent calibration and cross-calibration of the calibration facilities used by the Phase C/D contractors. The targeted completion date for all of the CCRs is the first quarter of calendar year 1995 to allow sufficient time to conduct several measurements with the CCRs at the contractor's and other calibration facilities.

VNIR CCR: The objective of this project is to design and build a 400 to 900 nm cross-calibration radiometer, test this radiometer, and write control and data acquisition software. This radiometer will be compared to NIST-traceable standards of spectral irradiance and HALON targets. Biggar designed the radiometer with three silicon detectors in a "trap" configuration. Spectral selection is through interference filters selected by manually turning a filter wheel. Two precision apertures determine the throughput. Heating the detector assembly, filters, apertures, and amplifier to a stabilized temperature, a few degrees above ambient, provides thermal control of the system. A commercial datalogger digitizes the amplifier output, and ancillary information such as detector temperature, and controls the amplifier gain through digital output ports. This datalogger sends the serial digital data to a MS-DOS compatible computer. The entire radiometer consists of the head with filter wheel, the electronics/power supply package, connecting cables, datalogger, and computer.

Biggar developed software for including a new programmable source into the blacklab, lamp-power-supply loop. He worked on repackaging the VNIR transfer radiometer into the new travel case and received a new high accuracy DVM for use with the radiometer and began developing GPIB code to use the DVM with existing radiometer software. He also started developing software for the new HP black-lab source. Nelson and Biggar documented the design of the radiometer and investigated possible designs for a smaller, more portable power supply. Biggar analyzed data from the radiometer taken during the June 1993 SeaWiFS cross-calibration experiment using preliminary filter response data. Further processing of these data has been hampered by malfunctions of the monochromator used for characterizing the filter responses.

SWIR CCR: The objective of this project is to design and build a 1100- to 2500-nm cross-calibration radiometer, test this radiometer, and write control and data acquisition software. This radiometer will be compared to NIST-traceable standards of spectral irradiance and HALON targets. Spyak began investigating the use of the SWIR spectroradiometer described in a later section for use as the SWIR CCR prototype.

TIR CCR: The objective of this project was to design and build cross-calibration radiometers to cover the 3000- to 14500-nm spectral region, test these radiometers, and write control and data acquisition software. This radiometer was to be designed for precision only.

Spyak continued investigating thermal cross-calibration radiometer designs. He reviewed the MODIS and ASTER specifications to determine the transfer radiometer's design requirements. Software was written to analyze radiometer designs, and Spyak began preparing a questionnaire on thermal transfer radiometers that is to be sent to members of the EOS Calibration Panel. Spyak also developed a white paper on the thermal transfer radiometer. During the March budget exercise mentioned above, it was decided not to construct thermal radiometers that would operate in thermal vacuum because budget cuts will not allow adequate radiometers to be built. After further budget studies, it was determined that no thermal cross-calibration radiometer will be built.

Reflectomobile: The task objective is to design a vehicle and instrument package to perform field-surface-reflectance measurements more accurately, efficiently and repeatably with only one person. In the past, people have carried yokes which extend the radiometers away from the walker's body to reduce shadow and other problems. This method requires the involvement of at least three people, takes about 40 minutes to cover a 0.02 km^2 site, and depends on the ability of the walker to orient the radiometer correctly. Construction of the reflectomobile is complete but tests and modifications continue.

We determined from aircraft-based imagery that the tracks left by vehicles driving over the White Sands test site could bias our reflectance-based calibrations. D. Gellman and Thome examined the possible effect of the reflectomobile's tire tracks on the surface reflectance measurements for the reflectance-based vicarious calibration. During the recent March trip to White Sands we collected data to examine the impact of the tire tracks on the retrieved site reflectance. Possible solutions to this problem include carefully characterizing the track's effects and accounting for them in the calibration work, or reverting back to using yokes for reflectance measurements. These solutions are currently being investigated. Gellman also began looking at the possibility of mounting the reflectomobile to the truck in an attempt to reduce instrument vibration, but this work is being delayed until a decision is made on the extent of further use of the reflectomobile.

Mobile Laboratory: The objective of this task is to design a mobile laboratory for 1) storage and transportation of equipment; 2) electricity (AC and DC) for equipment; 3) shelter from the sun, heat, and cold for computers and people during measurements and for all of our equipment overnight at experiment sites; and 4) a roof platform for certain instruments, especially the solar aureole meter and some meteorological instruments.

Gellman used these criteria to design the proposed version of the mobile laboratory. We intend it to consist of a fifth-wheel, gooseneck trailer towed by a pickup truck with dual rear wheels. With this arrangement we can detach the mobile laboratory at the site during multiple-day experiments; use the tow vehicle for reflectance measurements; and substitute a different tow vehicle if the pickup truck breaks down. D. Gellman examined the list of surplus vehicles which might be suitable for the mobile laboratory and developed a list of criteria to discriminate between vehicles. On March 3, Biggar inspected a mobile laboratory at NSA with a view to acquiring it for field calibration purposes. Gellman redesigned the mobile laboratory because of the lack of response to our first design. This has been resubmitted for bid.

SWIR spectroradiometer: The objective of this task is to design and construct an instrument to measure surface reflectance in the SWIR region of the spectrum. When our contract began, M. Smith had already designed and built the prototype. P. Spyak is currently examining the possibility of using the instrument as a prototype for the SWIR cross-calibration transfer radiometer.

BRDF Meter: The objective for this task is to design and construct a device, and develop software for measuring the directional reflectance and inferring the bi-directional reflectance distribution function of the ground. The basic design incorporates a fisheye lens and a CCD-array detector.

M. Brownlee tested the saturation/blooming effects of the BRDF meter's CCD array when viewing both a 2% and 98% reflectance target in the FOV of the fisheye lens, and she intends to complete processing these data within the next 6-month period. A SCSI disk for the meter's controlling computer was ordered for testing stand-alone storage and processing of the data. The final specifications for the White Sands interference filters were determined and written quotes from prospective filter companies were obtained. The filters should be ordered in early July and we expect a fall delivery.

Diffuse-to-global meter: The objective of this task is to design and build an instrument to collect diffuse-to-global irradiance data. By comparing the diffuse downwelling irradiance to the global (direct plus diffuse), an improvement to the atmospheric correction may be made which reduces the uncertainty of the reflectance-based method. Currently global irradiance data are collected using a radiometer viewing a reflectance panel and diffuse data are collected by manually positioning a parasol to shade the panel. The diffuse-to-global meter will collect these data automatically and more repeatably.

B. Crowther developed and modified his Monte Carlo code which models scattering in spherical integrating sources (SIS). He currently is able to model the scattering of a general, idealized SIS, Labsphere's SIS, and a modified SIS designed by Crowther. The goal of this modeling is to try and develop a precise cosine receptor for the diffuse-to-global instrument. Crowther solved a problem with the random number generator of this Monte Carlo diffuser code by implementing a random shuffling routine. Biggar and Crowther ordered a new spectroradiometer for field use and possibly for the diffuse-to-global meter. Crowther was informed that he had received a NASA fellowship for work on the diffuse-to-global meter.

Calibration Laboratory: The objective of this project is to develop a calibration laboratory that will provide the necessary high-radiometric-accuracy standards for 1) the cross-calibration radiometers and 2) the field and aircraft radiometers needed for preflight algorithm and code validation and the actual in-flight calibration of the EOS multispectral imaging sensors beyond 1998. Some of the equipment we intend to acquire include a spherical integrating source (SIS) to simulate at-satellite and field radiance levels and to allow intercomparison of instruments between 0.4 and 2.5 _m; stabilized lasers to provide stable discrete lines for detector-calibration and intercomparisons; cryogenic absolute radiometer to calibrate the stabilized lasers and therefore other radiometers (CCR and field); blackbody simulators for calibration of the TIR radiometers; NIST-traceable standard lamps; spectroradiometer for calibration of the SIS; and spectrophotometer. Recently, the stabilized lasers and cryogenic radiometers have been deleted from the project because of budget cuts. This new equipment will also require the development of methods needed to carry out the described laboratory work.

Nelson repaired the wiring in the blacklab shunt and reinstalled it. Spyak began investigating Algoflon F6 as a replacement for HALON as a reflectance standard in the blacklab. He also purchased optical hardware for the laboratory. Gellman and Spyak sent the blacklab shunt and multimeter to the manufacturer for calibration. Biggar ordered and received a 24-bit digital-to-analog converter for the blacklab to enable us to further automate our laboratory reflectance panel calibrations. He also ordered a highly accurate "transfer standard" voltmeter for the laboratory.

Biggar received and began evaluating a portable 6-inch SIS from Labsphere for use as a travelling standard for the VNIR and SWIR cross-calibration radiometers and a 40-inch SIS from Labsphere for instrument calibration and characterization. Nelson completed a current monitor break-out box for the 6-inch SIS. A drill press was purchased and received for our instrument assembly laboratory. Spyak researched, ordered, and received low-pressure line source lamps.

Nelson acquired the equipment to supply pure nitrogen to our Newport optical bench and attached plumbing to float it. He also attached plumbing to supply ultra-pure nitrogen to the Optronic monochromator. Spyak ordered and received a fiber optic illumination system, an x-y translation stage, and a laboratory jack for the calibration laboratory. He ordered and received a HeNe (0.6328 micrometer) laser, two adjustable-lens mounts, and spectral-line lamps. Spyak began investigating desired tissues, gloves, swabs, etc. for cleaning optics and obtaining information from various clean room companies.

Spyak ordered and received two monochromator attachments for transmittance measurements in the wavelength range of 0.25-6.0 micrometers. Biggar and Spyak began measurements to characterize the light leakage of the Optronic monochromator and started measuring the filters for the silicon-cross-calibration radiometer. During these measurements they determined that the Optronic monochromator was not functioning properly and returned it to the manufacturer for repair. Nelson designed a one-inch diameter filter adapter for use with the monochromator. Spyak updated the monochromator software. Spyak also performed a spectral calibration of the monochromator for the 0.4 to 1.1 micrometer range and determined it was out of specification. He generated a correction graph and Optronic indicated how to bring the unit back within specification. He performed another spectral calibration on the monochromator for the 0.4 to 1.1 micrometer region and modified the grating alignment factors to bring the monochromator back within specification. The monochromator chopper control board malfunctioned during further testing of the monochromator. Spyak obtained a replacement and installed the board and the monochromator is again functional.

Characterization of the monochromator continued. Repeatability from day to day appears to be better than 1%, but a definite number cannot be assigned yet. Occasional discrepancies still occur. The most recent was after disassembling, and then, reassembling, some of the system. These discrepancies are on the order of about 3%. This may be due to lamp warm-up time or room-temperature changes. We will continue to investigate this issue.

Algorithm and Code Development: Currently, several algorithms exist to perform our calibration work. The RSG has applied these algorithms as FORTRAN programs which are neither user friendly nor efficiently linked together into a single package. The task objective is to convert these existing codes into ANSI standard C in a user-friendly package with rules-based decision making in the package. The group is now also involved in the atmospheric correction of ASTER data in the solar reflective portion of the spectrum for which Biggar ordered a Sun SS20 612 MP workstation.

Thome spent much of the period working on the ASTER ATBD for the atmospheric correction in the solar-reflective part of the spectrum. He sent the final draft version to Kahle on

February 27 along with a cover letter for the Atmospheric Correction ATBDs. An iterative version of the radiative transfer code was completed and a copy emailed to Eng. Thome sent preliminary comments on the software requirements document to Voge and sent G. Geller of JPL inputs to the Standard Data Product Specification for ASTER. Thome continued work on the atmospheric correction for ASTER by supplying modifications of the data dictionary to B. Eng of JPL.

Field Experiments: The objectives of the field experiments are to test new equipment, determine needed improvements, test retrieval algorithms and code, and monitor existing satellites in much the same way as we shall for EOS sensors.

Gellman made preparations for a late March, early April, White Sands trip. He worked on the software for retrieving surface reflectance measurements in the field and measured/calibrated our field reflectance panels. Spyak investigated video camera systems for geo-referencing aircraft-based radiance measurements. He ordered and received a micro-video camera and hand-held VCR for this purpose. Gellman updated software used for the panel calibrations, solar radiometer data reduction, and solar ephemeris computations.

Biggar and Nelson designed a sample-and-hold device for aircraft-based radiance measurements. Nelson continued work on the sample-and-hold device by confirming the design, ordering the remaining parts, and contacting Circuit Engineering regarding the artwork and construction of the circuit boards. He received the ICs which were ordered for breadboarding the sample and hold and is now 25% complete with the breadboarding. Nelson completed a prototype design of a yoke to be used for surface reflectance measurements. This design was tested during the March White Sands trip. He is currently in the process of modifying the prototype based upon this first use of the yoke. Nelson documented the cabling used for our field experiment radiometers and ordered connectors for new cables to connect the Exotech and MMR to our Fluke Hydras.

Eight members of the group travelled to White Sands for satellite calibration work for SPOT-2, SPOT-3, and Landsat-5. We were accompanied by T. Clarke and M. Moran of the USDA ARS Water Conservation Lab in Phoenix. In addition to the calibration work, the trip was also used to examine possible new sites which could be used when the mobile laboratory is complete. We also used the trip to re-evaluate the use of yokes as a method for transporting instruments over the test site. Thome and C. Deschapelles began processing the data for the Landsat calibration and Gellman processed the data for SPOT-3 calibration.

The RSG travelled to White Sands Missile Range from April 29 until May 1 for calibration of SPOT-3 and Landsat 5. The experiment was designed to examine in-flight cross-calibration of separate sensors as both Landsat-5 and SPOT-3 satellites overflew the site on the same day at less than a 5 degree zenith angle. Unfortunately, range restrictions prevented helicopter data from being collected and clouds prevented an adequate data set for testing the in-flight cross-calibration of the two sensors. Data collected will still be used to attempt a reflectance-based calibration of Landsat-5 TM.

K. Scott began investigating new calibration sites. She met with R. Green of JPL at the Orlando SPIE Meeting to discuss their use of Lunar Lake for AVIRIS calibration. This has started activity by Biggar, Scott, and Slater to examine the area as a possible target for our use. Scott is also investigating the Railroad Valley Playa near Lunar Lake, Owens and Death Valleys, and the salt flats of Utah. She contacted M. Abrams of JPL regarding CIA SPOT imagery in an attempt to obtain PAN-band imagery of Utah, Lunar Lake, Railroad valley, Death Valley, the Arizona deserts. She is currently working with the Desert Research Institute to obtain Landsat data of these areas.

Non-EOS-related activities: These activities are those performed by members of the RSG during the month of June only which are not directly related to our EOS activities. Biggar installed the newly received SPARCstation 20 in Thome's office. This new machine is named "titan" and uses the new Solaris operating system. "Charon" has been moved to the computer room and is available for general usage. Biggar also installed the new operating system on io as well as the new disk package and worked on improving our radio link connection to the University ethernet system and evaluated newly received computer hardware. Brownlee continued working on her dissertation proposal. Spyak continued developing a field-trip improvement list, organizing the August White Sands trip, developing a checklist for ground-reflectance measurement field equipment and labeling corresponding equipment. He is receiving training for SPOT calibration data reduction and will have a French student working with him comparing HALON and Algoflon.

Scott worked on becoming more familiar with the operation of the radiative transfer code UAFLAT. She used the code to investigate the effect of reflectance errors on top-of-the atmosphere radiance. She noted a 1% uncertainty in deriving the digital counts from Landsat data of Chuck Site because of uncertainties in locating the tarpaulin. She also evaluated IDL and decided to use this language as the platform for the user programs she is developing. She developed a program which searches two images to find the best correlation and is using the KHOROS derived test images to test the program. This program will be used after a best-guess registration of two images using ERDAS.

R. Parada altered 6S to allow tests concerning the effect of aerosol particle distributions on the at-satellite SeaWiFS radiance signal to be determined. Results show very slight (less than 5%) changes in band 1 and band 8 radiances as each type of particle was increased from 0% to 100% of the aerosol makeup while remaining particulate concentrations were decreased equally. These results show the relatively small dependence of radiance signal on aerosol content. He developed a series of software routines aimed at developing a more accurate radially-symmetric approximation to the Cox and Munk wave-slope distribution model. The software is now in the operational stage and is currently being employed to arrive at the improved wave-slope distribution function. A scouting trip to Lake Tahoe is planned for July 6-8 to ascertain the best location(s) for data collection during SeaWiFS calibration campaigns which are expected to begin in the summer of 1995. Final decisions recommendations are expected by the middle of July regarding the new weather station.

S. Recker made arrangements and delivered a working lunch to the ASTER delegation from JPL that visited on June 7. She made vehicle arrangements for Biggar and Thome's trip to Los Alamos, NM and created an announcement, and sent copies to several departments for posting, for a talk to be given at the Optical Sciences Center by Michael Descour. Recker prepared the copier report for billing purposes, and she spent several days putting the requisitions for the computer section of the contract in order. This included separating the requisitions that have been transferred from 348870 to 348871, verifying that they are indeed computer oriented, entering the information into the Lotus database and having monthly cover sheets for all requisitions. She balanced expenditures to FRS sheets on all twelve accounts and prepared 1994-95 requisitions for Maintenance Agreements on all hardware and software blanket orders. Now that summer is here, Slater and all students need to fill out a time sheet in order to be paid and Recker ensures that everyone has turned one in and, if they are out of town, fills it out for them. She sent letters requesting continuing funding for EOS projects to all of the Arizona senators and congressmen. She is removing old files from the filing drawers to free up space and refiling them in storage boxes in another location. In addition, she performed the normal office tasks of filing, answering phones, copying, organizing Slater's mail, typing up travel and making sure checks are issued in the correct amount, and ordering office supplies.